REMARKS

Reconsideration of this application, as amended, is respectfully requested.

The indication of allowable subject matter is gratefully acknowledged.

Claims 17-32 have been canceled without prejudice, and new claims 33 to 65, are presented. Claim 33 is a combination of canceled claims 17 and 22.

New Claim 34 is a combination of former claim 17 and also recites that the spacers can be made totally of ceramic material (specification, page 6, description of fig. 9).

The remaining claims are similar to formerly pending dependent claims.

It is not believed that the 35 USC § 112, first paragraph rejections apply to the presently pending claims.

Claims 17, 23-27 and 32 were rejected as allegedly anticipated by Dexter. Claims 18-20 and 31 were rejected as allegedly obvious over Dexter in view of DE '457 or JP '976. Claim 21 was rejected as allegedly obvious over Dexter in view of DE '457 or JP '976 further in view of Brundige. Claim 22 was rejected as allegedly obvious over Dexter in view of GB '381. Claims 17-20, 23-27 and 31-32 were rejected as allegedly obvious over Brundige in view of Dexter. Claims 22 was rejected as allegedly obvious over Brundige in view of Dexter and GB '318. To the extent, if any, the rejection might be applied to the presently pending claims, Applicants respectfully traverse.

Dexter discloses an infrared radiation source with a heating element made of carbon fibers in a quartz glass tube. The heating element is spaced from the tube by means of a carbon fibre or graphite paper yoke (Dexter, col. 8, lines 28-30). Dexter does not disclose an arrangement of a ceramic between yoke and heating element or a yoke totally made of ceramic material like aluminum oxide or zirconium dioxide.

GB '818 discloses an electric heating element with a metallic heating filament in a metallic tube. The metallic heating filament is spaced from the metallic tube by insulating supports. In detail, in fig. 2 there is disclosed a metal disc 13 having a central hole 14 for the filament 11. The metal disc 13 is clamped by an annulus of heat-resisting material as alumina (Lewis, page 2, left columns, lines 3-20). GB '818 does not disclose the arrangement of a ceramic between heating filament and spacer nor does it disclose a heating element containing carbon fibers arranged in a quartz glass tube, which is supported by spacers of aluminum oxide or zirconium dioxide.

Brundige discloses a heat lamp with a filament support structure for a coiled filament made of refractory (metal) wire. A disc-shaped filament support is disclosed, which is made of tantalum or other suitably refractory material (see claims and col. 2, lines 54 to 62). Brundige does not disclose the arrangement of a ceramic between heating filament and spacer. As well, Brundige does not disclose a heating element containing carbon fibers (which is not a refractory wire) arranged in a quartz glass tube, which is supported by spacers of aluminum oxide or zirconium dioxide.

A combination of Dexter and Lewis or Dexter and Brundige or Brundige and Lewis would not lead one skilled in the art to arrive at the invention of new claims 33 or 34 of the present invention for reasons that follow.

It is of utmost importance for the present invention, that the heating element containing carbon fibers is not in direct contact to a spacer made of metal or carbon, as it was discovered that at the contact points between a carbon filament and a metal or carbon spacer a fault current flow occurs during operation of the infrared radiator. The filament scorches at the contact points and becomes weak. As a result, the electrical resistance of the filament increases in the area of

the contact points. That leads to "hot spots", which weak the filament too. A premature burning through of the carbon filament results. It was found that the use of ceramic material instead of metal or carbon in contact to the carbon filament prolongs the service life of the infrared radiator. Thus, it is not the same to arrange the ceramic material between spacer and tube, because this way the fault current between spacer and filament could not be prevented.

The remaining secondary references do nothing to overcome the deficiencies of the above-mentioned references. It is respectfully submitted that all rejections of claims based on the cited references have been overcome.

A substitute specification and a marked up copy of the specification showing the changes are enclosed. Please enter the substitute specification.

Formal drawings will be provided in a separate letter to the draftsman.

In view of the foregoing, it is respectfully submitted that all rejections have been overcome and that the application is in condition for allowance. Early issuance of a Notice of Allowance is earnestly solicited.

Any fees due to enter this amendment may be charged to deposit account number 50-0624.

Respectfully submitted,

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INFRARED RADIATOR WITH CARBON FIBER HEATING ELEMENT CENTERED BY SPACERS

~~**Infrared Radiator**~~

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to an infrared radiator having a heating element disposed in a quartz glass tube and a heating element containing carbon fibers, the ends of the heating element being connected to contact elements passing through the wall of the quartz glass tube. The invention furthermore relates to a method for the operation of such an infrared radiator.

Infrared radiators of the stated kind are disclosed, for example, in DE 198 39 457 A1. They have spiral-shaped heating elements of carbon fibers. Such carbon fibers have the advantage that they permit rapid temperature change, so they are characterized by great speed of reaction. Due to its spiral shape and the great surface area which it provides, the known carbon radiator has a relatively high radiation output and is suitable for operation at temperatures below 1000°C. In its practical form, heating element temperatures of maximum 950°C are preferred. The achievable radiation power is limited by this top temperature limit.

Similar infrared radiators are described in DE 44 19 285 A1. Here a carbon ribbon is formed in a serpentine manner from a plurality of interconnected sections. GB 2,233,150 A likewise discloses infrared radiators in which the heating element is configured as a carbon ribbon. Infrared radiators with metallic heating elements are disclosed in DE-GM 1,969,200 and in GB 1,261,748 and EP 163 348 A1. On account of a relatively small surface area, these also can achieve only limited radiation output. It is known especially from the last two disclosures named to configure the heating elements such that they are in contact with the

the ends of the heating element and the contact elements, in order to optimize the galvanic contact between the contact element and the carbon fibers of the heating element. The heating element appropriately consists substantially or exclusively of carbon fibers.

Between the graphite and the heating element, a noble metal paste and/or a metallic coating applied to the ends of the heating element can be provided. The metal coating can be formed of nickel or a noble metal and can preferably be applied galvanically.

Thus the contact is further improved. Welding of the contact-making parts can be done by resistance welding or laser welding.

The problem is solved for the method of operating an infrared radiator in that the heating element is heated to a temperature greater than 1000°C, preferably greater than 1500°C.

An embodiment of the invention will be explained with the aid of a drawing, wherein: of drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a spiral carbon radiator pursuant to the invention,

Figs. 2 - 9 various embodiments for spacers,

Fig. 10 a contact element,

Fig. 11 the arrangement of a contact element on the heating element,

Fig. 12 a schematic view of the making of a contact,

Fig. 13 a section through the contact with spot weld,

Fig. 14 a contact with the heating element, and

Fig. 15 a schematic cross section of the contact.

DETAILED DESCRIPTION

In Fig. 1 there is represented an infrared radiator in accordance with the invention. In a

Claims

It is claimed:

1. Infrared radiator with a heating element containing carbon fibers and arranged in a quartz glass tube, with its ends joined to contact elements running through the wall of the quartz glass tube, characterized in that the heating element (2) is spaced away from the wall of the quartz glass tube (1), and that the heating element (2) is centered on the axis of the quartz glass tube (1) by means of spacers (3).

2. Infrared radiator according to claim 1, characterized in that the heating element (2) has the form of a spiral or coiled ribbon.

3. Infrared radiator according to claim 2, characterized in that the inside diameter of the quartz glass tube (1) is at least 1.5 times as great as the diameter of the spirals or coils of the heating element (2).

4. Infrared radiator according to at least one of claims 1 to 3, characterized in that the spacers (3) are formed from molybdenum and/or tungsten and/or tantalum or an alloy of these metals.

5. Infrared radiator according to at least one of claims 2 to 4, characterized in that the spacers (3) have, at least on their side facing the heating element (2), a length in the